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# FACTS AND THEORIES OF TELEGONY.

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It will be remembered that Professor Weismann, in a chapter of *The Germ-Plasm*, entitled "Doubtful Phenomena of Heredity," referred to what is generally known as *infection of the germ*, and gave to it the term "Telegony." Although he expressed some doubts as to the existence of the phenomenon, believing that the recorded instances of "infection" were based upon an insufficiency of data or misinterpretation of facts, he felt justified in considering its occurrence *possible*, since supposed cases of infection had been often discussed, and even Darwin had considered the subject worthy of special mention.

The belief that the male of the first coitus may influence the color, structure, and disposition of the young born to a female, of another sire, is almost universally held by stock-breeders, and so tenaciously that even the accidental contamination of a pure-bred female by a male of inferior blood renders her permanently undesirable for breeding purposes.

The question, however, had received no special attention from biologists previous to the Spencer-Weismann controversy of 1893. At that time Spencer accepted telegony as an incontestable fact, called attention to experiments made by Mr. Nouel upon sheep, and described in the *Journal of the Royal Agricultural Society* for 1853; to others made upon pigs by Daniel Giles, Esq., and reported in the *Philosophical Transactions* for 1821; and to the famous experiment of Lord Morton, in which a nearly full-blooded Arabian mare, having been mated to a quagga, by which she had a hybrid foal, subsequently bore to a full-blooded Arabian stallion two foals, which were said to simulate the markings of the quagga. He concluded: "And now, in presence of these facts, what are we to say? Simply that they are fatal to Weismann's hypothesis. They show that there is none of the alleged independence of the reproductive cells; but that the two sets of cells are in close communion. They prove that while the reproductive cells multiply and arrange themselves during the evolution of the embryo, some of their germ-plasm passes into the mass of somatic cells constituting the parental body, and becomes a permanent component of it. Further, they necessitate the inference that this introduced germ-plasm, everywhere diffused, is some of it included in the reproductive cells subsequently formed. And if we thus get a demonstration that the somewhat different units of a foreign germ-plasm permeating the organism, permeate also the subsequently formed reproductive cells, and affect the structures of the individuals arising from them, the implication is that the like happens with those native units which have been made somewhat different by modified functions: there must be a tendency to inheritance of acquired characters."

Romanes expressed himself more cautiously. While admitting that telegony occurred, he questioned its frequent occurrence, and could not accept Spencer's explanation, nor agree with him that the phenomenon disproved Weismann's doctrine of the isolation of the germ-plasm.

In 1896 Dr. A. L. Bell published an article in the *Journal of Anatomy and Physiology,* in which he described several cases that purported to illustrate the influence of a previous sire, and described several experiments that he had made upon horses and dogs for the express purpose of producing results which might be attributed to the influence of telegony. In the same year Karl Pearson examined the matter statistically, and showed that in man there was no evidence that the younger children of a family have characters more nearly resembling those of the father than do the eldest, for it is evident that if telegony really occurs the later offspring of the "infected" mother would resemble the father more than would the first-born.

Mr. Bulman has more recently called attention to the bearing that "hybrid-oölogy" has upon the question of telegony. The eggs deposited by a female bird of a certain species, after she has been mated to a male of another species, will often resemble, in their coloration, the eggs of the latter species. This fact, which appears to be well established, has been thought to prove that the sperm influences not the ovum alone, but the walls of the oviduct, which in turn imprint their acquired character upon the eggshell. It seems to the writer, however, that one is not driven to accept such a phenomenon as an instance of "maternal infection." The hen's egg is not the product of the undirected metabolic activity of the hen alone, but is the result of the joint activity of the combined oöcyte and sperm, — the oösperm, — and the coverings of the egg, the membranes and shell, in their elaboration, must be affected as well by the centrifugal influence of the oösperm as by the centripetal influence of the oviducal walls. The egg takes unto itself what it selects, not merely what is thrust upon it.

A paper strongly in favor of telegony, and partially based upon experiments, was written by Mr. Frank Finn, at the time of the Spencer-Weismann controversy, and published in *Natural Science.* The observations therein recorded, especially those upon varieties of the domestic fowl, are exceedingly interesting, and one would almost become convinced, had the experiments been made for the express purpose of securing definite data bearing upon the disputed question, and had adequate precautions been taken for the exclusion of errors. But it is this very lack of definite data, and the frequent admission of evidence based upon anecdotes and traditions of obscure origin, that have made so many of the communications inconclusive and unsatisfactory. Of an entirely different nature are the efforts of Professor J. C. Ewart of the University of Edinburgh, who has lately published some of the results of his "Penycuik Experiments"; but although his work has received the well-merited attention of the British journals, American publications have been almost shamefully indifferent to its importance.

Professor Ewart began his experiments in 1895, when he secured three male Burchell's zebras. Two of these died, but the third became thoroughly acclimated. This zebra was mated to Mulatto, a black West Highland pony, and the hybrid colt Romulus, born in August, 1896, was even *more profusely striped* than the sire, which in its figure and general behavior it strongly favored. Now, following Lord Morton's experiment, Mulatto was sired by an Arabian horse, and, lo! and behold! like Lord Morton's colt, Mulatto's foal presented a number of stripes, although these were indistinct and visible only in certain lights. A third foal, born to Mulatto in May of the present year by a West Highland pony, Loch Corie, also showed indistinct markings.

It would thus appear at first sight that Mulatto's second and third foals lend support to the belief in telegony, but the Scotch professor did not stop here. Soon after the birth of Mulatto's third foal, two West Highland mares, similar to her, but neither of which had ever seen a zebra, had colts by Loch Corie, both of which were striped. It is thus seen that striped colts may be born to full-blooded parents without the "infection" of a zebra sire, and we are practically forced to give up our interest in the offspring of Lord Morton's mare.

Further experiments of Professor Ewart are as follows: A Shetland mare, mated to a black Shetland pony, had as her first foal a colt distinctly striped. Mated to the zebra, her second foal was the most zebra-like of all of Professor Ewart's hybrids; but when again mated, to a Welsh pony, her third foal, born after she had had an opportunity to become infected by the zebra or its hybrid foal, did not begin to have the conspicuous zebra-like markings of the first foal.

The crossing of Iceland, Irish, English thoroughbred and Arabian mares with the zebra, and the breeding of them subsequently to their own or closely related varieties, failed to afford the slightest evidence in support of the theory of the infection of the germ.

Although the "Penycuik Experiments" were evidently undertaken for the express purpose of proving the truth or falsity of the supposed phenomena of telegony, Professor Ewart struck upon certain by-products of no inconsiderable scientific value. It will be recalled that the existing striped horses are grouped under four species: the quagga (*E. quagga*) of South Africa, the most ass-like, and the one of Lord Morton fame; Burchell's zebra (*E. burchellii*), the species used by Professor Ewart, and occurring on the plains north of the Orange River; the true zebra, or mountain zebra (*E. zebra*), and the Somali zebra (*E. grevyi*) of Northeastern Africa. Professor Ewart is of the opinion that, as far as the coloration is concerned, the last is the most primitive of living zebras, and the colors and markings of the hybrid foals resemble those of this species rather than the color-pattern of their sire. In other words, the process of hybridization results in the resurrection of ancestral characters which have long remained latent, and his experiments show also that even the mere crossing of varieties, or the in-breeding of domestic animals may lead to the production of offspring possessing characters which are to be explained only on the principle of reversion.

Turning to Darwin's *The Variation of Animals and Plants under Domestication*, we read under the caption "Crossing as a Direct Cause of Reversion":

"It has long been notorious that hybrids and mongrels often revert to both or to one of their parent forms, after an interval of from two to seven or eight, or, according to some authorities, even a greater number of generations. But that the act of crossing in itself gives an impulse toward reversion, as shown by the reappearance of long-lost characters, has never, I believe, been hitherto proved. The proof lies in certain peculiarities which do not characterize the immediate parents, and therefore cannot have been derived from them, frequently appearing in the offspring of two breeds when crossed, which peculiarities never appear, or appear with extreme rarity, in these same breeds, as long as they are precluded from crossing."

Lord Morton's mare was used by Darwin in this chapter, not because of its telegonous young, but because its first foal, the hybrid, had stripes "*more strongly defined and darker than those on the legs of the quagga.*" Professor Ewart, not alone by his experiments upon horses and zebras, but by experiments upon pigeons, fowl, and rabbits, has provided an abundance of evidence to prove the correctness of Darwin's views as set forth in this chapter, but he certainly shows that Darwin spoke with insufficient evidence when he said: "There can be no doubt that the quagga affected the character of the offspring subsequently begot by the black Arabian horse." His experiments, moreover, have yielded most welcome information of a definite nature respecting the benign and baneful effects of inbreeding, the unsettled questions bearing upon sterility and the strange phenomena which are associated with the word "prepotency." Both men of science and those interested in the practical occupation of breeding owe a debt of gratitude to Professor Ewart, an obligation that J. Arthur Thomson has acknowledged in a recent article in *Natural Science*, but a testimonial even more fitting would be the adoption of similar lines of research by our numerous and amply equipped agricultural schools and experiment stations. The vexed problems of heredity never will be solved until a great many individuals or institutions seriously undertake experimental breeding.

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